

DOCUMENT RESUME

ED 465 783

TM 034 168

AUTHOR Bastick, Tony
TITLE The Alignment Method of Measuring Quality Teaching at Tertiary Level.
PUB DATE 2002-04-00
NOTE 17p.; Paper presented at the Annual Meeting of the Western Psychological Association (Irvine, CA, April 14-17, 2002).
PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS College Faculty; *College Students; Educational Quality; *Evaluation Methods; *Higher Education; Instructional Effectiveness; *Measurement Techniques; *Student Evaluation of Teacher Performance; *Teacher Effectiveness
IDENTIFIERS *Curriculum Alignment

ABSTRACT

This paper reports an inexpensive and efficient alternative method of measuring teaching quality. The method aligns students' in-course expectations for change with their lecturers expectation for change in three process objects: Skills, Understanding, and Attitudes. It is shown, using sample course data, that these in-course alignment indicators predict quality teaching, which is measured after the course using outcomes of students' academic achievements and course enjoyment. Traditional student evaluations of teaching are post-mortem measures that do not provide feedback to help the students in the course. However, a major contribution of the alignment method is that optimum in-course changes can be calculated to minimize the in-course alignment scores for the whole course or for any student subgroup of interest, thus maximizing students' predicted attainments. As the method only takes 5 minutes to administer, it can be introduced at the level of the individual instructor who wishes to keep his or her teaching on track. The alignment method uses a single form and results in one decision point number. It can be used by the administration at the end of courses for comparable promotion and tenure decisions across the institution. Web-based alignment software is now being developed to enable lecturers and administrators from tertiary institutions worldwide to avail themselves of the method. (Contains 9 tables, 5 figures, and 23 references.) (SLD)

The Alignment Method of Measuring Quality Teaching at Tertiary Level

Tony Bastick
University of West Indies

Paper presented at the Western Psychological Association
WPA 2002 Convention
Irvine, CA
USA

Publication Date: April, 2002

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The Alignment method of measuring Quality Teaching at Tertiary level

Tony Bastick
University of the West Indies

Abstract

For over 30 years tertiary institutions have used anonymous Likert type student feedback response forms to assess quality of teaching. Institutions have increasingly used these Student Evaluations of Teaching (SETs) to also inform tenure and promotion decisions. Accountability requirements of Quality Assurance have now made the practice almost universal. Yet, it is widely recognized that these combined uses of SETs result in significant problems including 'grade inflation' and limitations on academic freedom. It has also been demonstrated that lecturers can use simple techniques to increase their SET scores without increasing the quality of their teaching. It seems that SETs have continued to be used because there has so far been no cost effective and efficient alternative method of measuring teaching quality.

This paper reports an inexpensive and efficient alternative method of measuring teaching quality. The method aligns students' in-course expectations for change with their lecturer's expectation for change in three process objects; namely Skills, Understanding and Attitudes. It is shown, using sample course data, that these in-course alignment indicators predict Quality Teaching, which is measured after the course using outcomes of students' academic achievements and course enjoyment. Traditional SETs are post-mortem measures that do not feedback to help the students on the course. However, a major contribution of the alignment method is that optimum in-course changes can be calculated that minimise the in-course alignment scores, for the whole course or for any student sub-group of interest, and thus maximise the students' predicted attainments. Hence, as the method only takes five minutes to administer, it can also be introduced at the level of the individual instructor who wishes to keep his or her teaching on track.

The alignment method uses a single form and results in one decision point number. Thus, it can be used by the administration at the end of courses for comparable promotion and tenure decisions across the institution. Other benefits of the method will be discussed. The method is being continually up-graded and web-based alignment software is now being developed to enable lecturers and administrators from tertiary institutions worldwide to avail themselves of the method.

Introduction

This paper briefly reports an alternative system for assessing quality teaching in tertiary institutions and focuses on the use of student feedback. The traditional method of assessing quality of teaching has been by questionnaires that ask students to anonymously rate the quality of teaching on a 4 or 5 point Likert scale from strongly disagree to strongly agree. In the literature, the use of these forms is called Student Evaluations of Teaching (SETs).

SETs have been used in universities for more than thirty years as part of the Quality Assurance Cycle to assess the quality of teaching and as an indicator of successful teaching for promotion, award and tenure decisions. Unfortunately, their use has been accompanied by many counter-productive effects such as discouraging innovative teaching, and deterring instructors from challenging students (Damron, 1995; Murray, 1984; Ruskai, 1996). Although their outcomes are intended to improve teaching, a major negative effect of also using them to varying degrees for promotion and tenure decisions has been to contribute to the lowering of

academic standards. Results of analyses of SETs and expected grades suggest that instructors can “buy” better evaluations via more lenient grading (Krautmann, & Sander, 1999). In the copious literature on the subject, this effect is referred to as ‘grade inflation’ or ‘dumbing down courses’ and some universities who use SETs now make statistical adjustments for these effects (Gillmore, & Greenwald, 1999). SETs have become known as little more than ‘smile sheets’ measuring popularity and ‘customer satisfaction’ (Altschuler, 1999), and lecturers have developed many methods for improving their SET scores that do not necessarily improve their teaching (Crumbley, 1995). It seems that one reason SETs continue to be used is that there has not been an expedient alternative. This paper reports such an alternative - the Alignment method.

The paper demonstrates an alternative method of using students’ evaluations of teaching (SETs) that circumvents many of the problems associated with traditional SETs. In particular, it shows how in-course feedback, consisting of eight ratings, can be used to optimize post-course academic attainment. The method is illustrated with data from course feedback at the University of the West Indies.

Traditional Student Evaluations of Teaching (SETs) are feedback forms returned by students near the close of a course. Institutions intend that data from these forms be used to improve quality of teaching and as an assessment of quality of teaching for deciding faculty promotion, award and tenure decisions. Although it is recognized that students can offer valuable information on the appropriateness of teaching quality, it has also been recognized that these traditional SETs are likely to have negative effects on the quality of teaching. These negative criticisms are quite extensive and range from what is referred to as ‘dumbing down’ of courses to restrictions on academic freedom (Gillmore, & Greenwald, 1999; Simon, 1996). One patently obvious criticism is that the information given by one group of students at the end of a course cannot be used to improve the teaching on that course for the very students to whom the feedback applies. Similarly, it can only be useful to future students to the extent that future groups of students are similar to the feedback group and to the extent that the course and teaching remain similar. However, courses and teaching methods hopefully evolve and the constituent subgroups of a student cohort can change considerably from one teaching of the course to the next.

This paper introduces an alternative method of allowing students to assess the quality of teaching that circumvents many of the problems associated with traditional SETs. In particular it allows feedback to be used for optimizing teaching quality during the course for the whole class, for individuals or for identified sub-groups of students within the whole group. The feedback is efficient to process - as it requires only eight ratings from each course member. This more timely feedback and optimization allows teaching choices for keeping teaching on track for the very students who are giving the feedback. An added advantage is that the method can be used by administration at the close of a course to calculate a single indicator of teaching quality that can be used for comparative promotion, award and tenure decisions across the institution. The paper explains how the use of this indicator protects lecturers from students’ intransigence and protects the institution from ‘dumbing down’ of courses.

The paper outlines the method and the theory behind it. The reliability and validity of the method is demonstrated with actual data from a course assessment. The method operationally defines three educational process objectives - Skills, Understanding and Attitudes. These three objectives are emphasized to a determined amount in the teaching and assessment of courses using this method. Feedback forms used during the course give data on the lecturer’s and students’ expectations for change in the emphasis of these objectives. This data allows for calculations of the alignment between the lecturer’s and the students’ expectations for change. The Alignment theory presented here is that students’ academic success and enjoyment of teaching are maximized when students and their lecturer are working towards the same changes. The theory is re-validated with each course by correlations of alignments with results, which show that in-course alignment predicts post-course academic success. This paper describes how the data are also used during the course to determine the changes that will best align in-course student/lecturer expectations and so maximize predicted post-course academic attainment for the whole group or for different student sub-groups who are taking the course.

The educational importance of this Alignment method is that it offers an efficient and effective alternative to the widespread problematic use of traditional SETs for quality control of teaching in tertiary institutions.

The Alignment method

Cohen (1994) has introduced to education the term 'instructional alignment', meaning the alignment of teaching, assessment and objectives. Instructional alignment has been found to compare favourably with the use of other commonly used strategies intended to improve learning performance, such as criterion-referenced tests, curriculum-based measurement, direct instruction, learning strategies, peer tutoring, self-instructional training, cooperative learning and computer-assisted instruction (Ippolito, 1990; Redding, 1992; Vergason, & Anderegg, 1991). Elia (1994) and Walker (1998) found that instructional alignment had an unusually high positive learning effect producing substantial improvement on the achievement levels of disadvantaged and low performing low socio-economic level school students. Similarly, results of a controlled experiment with community college learners comparing verbal mediation, feedback monitoring, and instructional alignment, showed that alignment had the greatest overall effect on achievement (Breitsprecher, 1991). Biggs (1999) highly recommends educational alignment for improving the quality of university teaching. It has been found that aligning teaching, assessment and objectives in tertiary education can increase learning performance by up to two standard deviations (Cohen 1987, 1991; Cohen, Hyman, Ashcroft, & Loveless, 1989).

There are many psychometric instruments that use what is referred to here as 'Alignment methods'. In an Alignment method a respondent's current state is assessed and his/her ideal state is also assessed on the same indicators. The difference between the current and ideal states is the measure of alignment. Where the difference is large, there is poor alignment which is indicative of problems. Where the difference is small, alignment is good, which indicates that the current state is close to the ideal. Improved alignment can also be used as a measure of successful intervention. What is crucial to the Alignment method is the choice of indicators measured to assess the current and ideal states. For each course, Cohen (1987, 1991) used three different

objectives that were derived from the course instructor's idiosyncratic values. However, to allow comparisons, the Alignment method introduced here, following Bloom's (1956) taxonomy of educational objectives, defines three standard process objectives that are emphasized to different degrees in quality teaching and learning.

These are Skills, Understanding and Attitudes operationally defined here as:

1. Skills – learning of facts/processes. Assessed by speedy accurate reproduction.
2. Understanding – professional competence. Assessed by justification of novel application and
3. Attitudes – professional values. Assessed by demonstration.

The method uses alignment on these process objectives as indicators of quality teaching. It should be noted that critical thinking is expected to be promoted by teaching and assessment of professional competence. This is because answers are not assessed as being right or wrong; only justifications that offer evidence of critical thinking are assessed. Alignment is not based on the course objectives but on the three process objectives. This is similar to common applications of Bloom's taxonomy, which also emphasise different levels within domains. The Alignment method uses course objectives and content as vehicles for emphasizing Skills, Understanding and Attitudes to the degrees deemed appropriate for the course. This emphasis will vary and reflect the course level and culture of the subject taught.

What are aligned are 'changes expected by the lecturer' and 'changes expected by the students' in each of these three process objectives. Numerically stated: $\text{Alignment} = \text{changes expected by Lecturer} - \text{changes expected by students}$. Zero is the perfect score, the theory being that students achieve higher standards if they and their lecturer are working towards the same changes. Figure 1 shows the eight core questions that the lecturer and each student answers for the alignment to be calculated.

These forms are confidential, not anonymous. When students enrol, the process objectives are explained with generalised examples related to teaching and assessment. As part of their orientation they pass a test on their competency to evaluate in order to earn the right to be considered as informed assessors. At the start of each course, their lecturer gives subject specific examples as part of the introduction to the course. It has been found that exemplary university teachers find their own different effective teaching dimensions and strategies to achieve excellence (Hativa, Barak, & Simhi, 1999). Hence, although staff development units may advise, the teaching techniques for attaining these goals are left as a matter of informed professional choice to the lecturer.

Figure 1: Five minute feedback form

Course Assessment - Skills, Understanding and Attitudes			
Estimate, <u>for you personally</u> , how much this course emphasises, and should emphasise (i) Skills, (ii) Understanding and (iii) Attitudes? Do this for both how the course is now , and for how the course should be - write a number in each box.			
	As it is now on this course	As it should be on this course	
(i) Emphasis on Skills (getting it right)	<input type="text"/> Your estimate out of 100	<input type="text"/> Your estimate out of 100	Write a Number in each box
	As it is now on this course	As it should be on this course	
(ii) Emphasis on Understanding (knowing why)	<input type="text"/> Your estimate out of 100	<input type="text"/> Your estimate out of 100	Write a Number in each box
	As it is now on this course	As it should be on this course	
(iii) Emphasis on Attitudes (relevance to your life)	<input type="text"/> Your estimate out of 100	<input type="text"/> Your estimate out of 100	Write a Number in each box
How much so far have you enjoyed your experience of the teaching on this course?		<input type="text"/> Your estimate out of 100	Write a Number in each box
Before you started this course, how much did you expect that you would enjoy your experience of the teaching on this course?		<input type="text"/> Your estimate out of 100	

Using data from the forms, individuals' alignments can be calculated and grouped to calculate and compare the mean alignments of any student sub-group of interest - males v females, experienced v novice students, older v younger students, option 1 v option 2 students, etc.

Two alignment scores are calculated;

- Alignment of Scope (changes in absolute quantity of the three objectives) and
- Alignment of Proportions (changes in relative quantity of the three objectives)

These calculations are explained in detail later in this paper (Tables 2, 3,, 4 and 7)

However, as we shall see, these formative Alignment indicators, that are measured during the course, are only predictors of quality teaching. They are not the criteria of quality teaching. The Alignment method separates the measurement of these in-course predictors of quality teaching from the post-course measurement of its two criteria of quality teaching. The two post-course summative criteria of quality teaching are:

- Students' academic standards and
- Students' enjoyment of the teaching

This Alignment method, unlike the traditional SET 'smile sheets', distinguishes between the assessment of enjoyment and the assessment of academic standards (Naftulin, & Ware, 1973).

Validation of the theory

When the courses are over and the academic results are compared with the alignment scores, it is possible to validate the theory for each course, and for each sub-group of students taking each course by correlating the 'Alignment of Scope' with 'Academic standards' and by correlating the 'Alignment of Proportions' with 'Enjoyment of teaching'.

Further, when the course has finished it is possible to use sensitivity analyses on the data to calculate those lecturer's changes that would have most aligned the teaching and thus, according to the Alignment theory, maximized the academic results and enjoyment of the students. Table 1 shows the computer analysis of actual Alignment data from forms as in Figure 1, and each part of Table 1 is explained in the following sections, starting with Figure 2 that highlights the main sections of the table. It is seen from actual Alignment data illustrated in Table 1, that the choice of these preferred changes would have increased the correlations between alignment and academic standards, thus further validating the theory that alignments are predictors of quality teaching. This is now described in detail.

Illustrative Results

Table 1 illustrates a typical computer data input, analysis and results sheet for the Alignment assessment of a course. These computer calculations are not normally shown as part of the method. Only diagnostic reports and summary results are normally reported. However, to explain the detailed workings of the method, these calculations are shown in this paper. The method is designed to be generalised across courses, lecturers, subjects, levels, institutions and cultures. However, this illustrative data is from a postgraduate teacher education course called 'Psychology for teachers' that was taken by 36 mainly mature students.

Figure 2 highlights the three main sections of Table 1, which is in three parts, Part 1 'For the Lecturer', Part 2 'For the students' and Part 3, the 'Summary Results'. Parts 1 and 2 hold data from the Lecturer's form and the Students' forms respectively. This data can be entered and analysed during the course to calculate Alignment predictors and optimal changes the lecturer should make to maximize students post-course academic attainment. Part 2 also has a section where the students' post-course academic results are entered so that the Alignment predictions can be validated. Part 3 holds results of calculations from the Lecturer's and Students' in-course data that show current in-course alignments resulting from the current changes that the lecturer is working towards. It also holds the optimal changes that the lecturer should work towards to maximise student attainment.

In Table 1, the results printed in bold type are the results of sensitivity analyses that minimise Alignments. In Part 1 of Table 1, the 'Start' row shows the first seven numbers input from the Lecturer's Alignment form displayed in Figure 1. The eighth number was not used for this analysis. Part 2 'For the Students' shows just a selection of four rows for students numbered #12, #25, #35 and #30, from the Alignment forms of all 36 students in this course. As well as the first seven numbers from the students' Alignment forms, these rows have been extended to show other variables for the identification of sub-groups of interest. The last column for the students shows their academic results. These were entered after the course and are used to validate the predictions from the in-course Alignment indicators and to further validate the Alignment theory. The 'Summary Results' section, Part 3, shows the calculated changes resulting from the lecturer's start position. There were six option groups in this class. Part 3 also shows results for lowest and highest attaining option groups - for Option 2 'History' students and for Option 4 'Modern language' students, respectively. All the computations are done by computer, but for elucidation the detailed calculations contributing to these results are illustrated in Tables 2, 3, 4 and 7.

Calculating Alignment of Scope

Table 2 shows how the six raw ratings of the process objectives given by the lecturer and the corresponding six raw ratings given by student #12 are used to calculate the Scope alignment for that student. The lecturer's raw ratings of 30, 40, 40, 45, 60 and 50 are taken from Table 1 Part 1 'For the lecturer'. The six

Figure 2: Schematic illustrating the main sections of Table 1

Part 1 For the Lecturer		Students' Post-course Academic results
Data from the Lecturer's form		
ALIGNMENT ASSESSMENT - DATA SHEET OPTIMISATION OF TEACHING		
Part 2 For the Students		
Data from the Students' forms		
Part 3 Summary Results		
Lecturer's changes in the three process objectives	In-course Alignment predictors	Post-course validations

Table 1: Example of computer input, analysis and results for the Alignment method

Part 1 For the Lecturer			Course ED40C		Date 15/11/00		Lecturer's Name ...						
	Skills		Understanding		Attitudes		Enjoyment	Student Variables of Interest				Academic Results for Post-course Validation	
	is now	should be	is now	should be	is now	should be		Sex	Age	Option	Years Teaching		
Start	30	60	40	45	60	50	50						
Best	30	30	40	44	60	71							
ALIGNMENT ASSESSMENT - DATA SHEET OPTIMISATION OF TEACHING													
Part 2 For the Students			# in class 36		# present 20								
#	Skills		Understanding		Attitudes		Enjoyment						
	is now	should be	is now	should be	is now	should be							
12	50	50	95	98	90	95	95	2	30	2	6	56%	
25	35	70	60	80	80	88	55	2	25	2	3	57%	
35	80	40	20	60	40	50	30	2	25	2	3	43%	
30	40	80	70	90	70	90	75	2	21	3	0	71%	

Part 3 Summary Results			Lecturer's changes				Alignment Predictors		Mean post-course results		Validation Correlations	
	Scope		Attitudes	Proportion			MScope	MProp	Enjoy	Acad	Scope	Prop
	Skills	Underst		Skills	Underst	Attitudes						
	Whole	Class			n=20							
Start	100%	13%	-17%	68%	-6%	-30%	1.499	1.259	69.5%	63.0%	-0.265	-0.278
Best	0%	10%	19%	-9%	1%	8%	0.674	0.507			-0.307	-0.576
	Option 2	History		n=3								
Start	100%	13%	-17%	68%	-6%	-30%	1.861	1.658	60.0%	52.2%		
Best	0%	33%	9%	-11%	18%	-4%	1.226	1.226				
	Option 4	Modern Languages		n=4								
Start	100%	13%	-17%	68%	-6%	-30%	1.200	0.972	72.5%	75.7%		
Best	13%	2%	6%	6%	-5%	-1%	0.223	0.203				

raw ratings given by student #12 of 50, 50, 95, 98, 90 and 95 are taken from Table 1 Part 2 'For the student'. For ease of comparison of how Scope and Proportion Alignments are calculated, the same raw ratings from student #13 are also used in Table 7 to explain the calculation of alignment of Proportion.

Table 2: Calculation of Scope Alignment

#12 Scope	LECTURER'S RATINGS			STUDENT'S RATINGS			ALIGNMENT	
	IS NOW	SHOULD BE	CHANGE (L)	IS NOW	SHOULD BE	CHANGE (S)	S-L	ABSOLUTE
SKILLS	30	60	100%	50	50	0%	-100%	100%
UNDERSTANDING	40	45	13%	95	98	3%	-9%	9%
ATTITUDE	60	50	-17%	90	95	6%	22%	22%
							TOTAL Scope	132%

The changes in Scope expected by the lecturer, and those expected by each student, for each process objective are calculated by dividing the difference between the raw ratings of the ideal state 'should be' and current state 'is now' by the raw ratings for the current state.

Using the raw ratings: Change in Scope = ('should be' - 'is now') / 'is now'

It is seen from Table 2, for example, that the lecturer's starting position for Skills of 30 for 'is now' and 60 for 'should be' requires a 100% increase, i.e. $(60 - 30)/30 = 100\%$. The student's starting position for Skills of 50 for 'is now' and 50 for 'should be' requires a change of $(50 - 50)/50 = 0\%$. It should be noted that the difference is 'grounded' by dividing by the starting position, resulting in a percentage increase. Just as \$100 can mean more to a poor person than to a rich person, this division is intended to compensate for the diminishing expectations represented by the same differences at higher parts of the scale. For example, an increase of 10 points from a low starting position of 5 up to 15 implies greater 'expectation' than an increase of the same 10 points from a higher starting position of 50 up to 60; namely $(15 - 5)/5 = 200\%$ compared to $(60 - 50)/50 = 20\%$.

The Alignment of each process objective is the difference in change expected by the Student (S) and the change expected by the Lecturer (L); Alignment = S-L. For example, Table 2 shows that the Skills alignment for student #12 is $0\% - 100\% = -100\%$. The negative sign indicates that the student is below the lecturer's expectation for Skills. However, the student's positive Attitude alignment of 22% indicates that the student is ahead of the lecturer's expectation for Attitude. Two further demonstrations of the calculation of Scope alignment are given in Figures 3 and 4. When the Alignment form is used in-course, these positive and negative process alignments can be reported individually or as sub-group statistics for the basis of diagnostic reports to guide teaching. However, it is the absolute alignments on the three process objectives that are summed to give the total Scope alignment for this student. The absolute values are chosen to be summed to avoid the possibility of positive and negative alignments cancelling each other and producing a result that would hide the degree of misaligned expectations. Again, absolute alignments can be reported individually or as sub-group statistics for the basis of diagnostic reports to guide teaching. However, it is the totals of the absolute Scope alignments that are used as predictors of academic attainment for individuals, for student sub-groups and for the group as a whole. The mean absolute Scope alignment for the whole group is the main indicator of quality teaching and predicts the academic attainment for the group.

Validating Scope alignment as a predictor of Academic Attainment

Alignment theory predicts that students will achieve higher academic attainments if they and their lecturer are working towards the same changes. Thus, to validate the theory we expect the more aligned students, the ones with the lower in-course Alignment scores, to have the higher post-course academic results. This can be tested for each course that uses the Alignment method simply by correlating in-course Alignment scores with post-course academic attainment. It can also be validated for student sub-groups by comparing the mean Scope alignments and mean academic attainments of the groups.

Post-course academic attainments for the illustrative data in Table 1 have been entered for individual students in the last column of Part 2 'For the students'. When we calculate the Scope alignment of the students we expect to find that their alignment and attainment is inversely related. Tables 3 and 4 give further examples of the calculation of Scope alignments for students #30 and #35 who have the highest and lowest academic attainments, respectively shown in Table 1.

Table 3: Calculation of Scope Alignment for student #30

#30	LECTURER'S RATINGS			STUDENT'S RATINGS			ALIGNMENT	
	IS NOW	SHOULD BE	CHANGE (L)	IS NOW	SHOULD BE	CHANGE (S)	S-L	ABSOLUTE
SKILLS	30	60	100%	40	80	100%	0%	0%
UNDERSTANDING	40	45	13%	70	90	29%	16%	16%
ATTITUDE	60	50	-17%	70	90	29%	45%	45%
							TOTAL Scope ALIGNMENT	61%

Table 4: Calculation of Scope Alignment for student #35

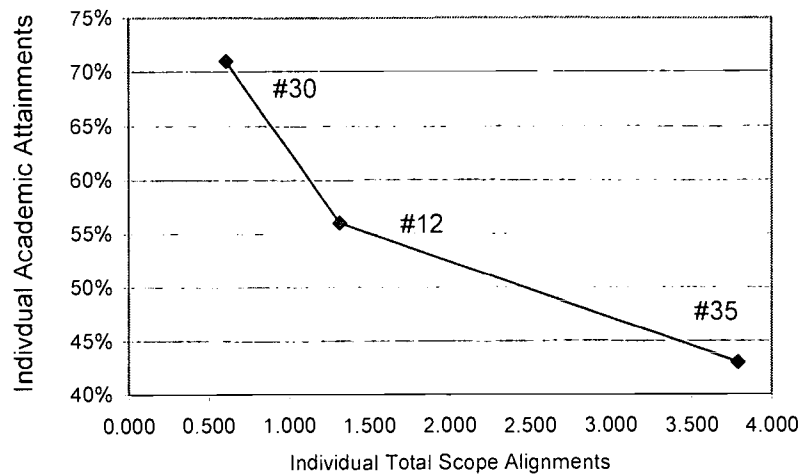
#35	LECTURER'S RATINGS			STUDENT'S RATINGS			ALIGNMENT	
	IS NOW	SHOULD BE	CHANGE (L)	IS NOW	SHOULD BE	CHANGE (S)	S-L	ABSOLUTE
SKILLS	30	60	100%	80	40	-50%	-150%	150%
UNDERSTANDING	40	45	13%	20	60	200%	188%	188%
ATTITUDE	60	50	-17%	40	50	25%	42%	42%
							TOTAL Scope ALIGNMENT	379%

Now that we have demonstrated the calculation of in-course Scope alignments for the three students #12, #30 and #35 we can compare them with the post-course academic attainments of these students as entered in Table 4. These paired predictors and criteria for the three demonstration calculations are tabulated in Table 5 and their relationship, illustrated in Figure 3, is seen to be inverse as predicted by the theory.

Table 5: In-course Scope alignments and post-course academic attainments for the three demonstrated calculations.

Student	Individual results	
	Total Scope Alignment	Academic Attainment
#30	0.61	71%
#12	1.32	56%
#35	3.79	43%

Figure 3: Relation between in-course Scope alignments and post-course academic attainments for demonstrated calculations.

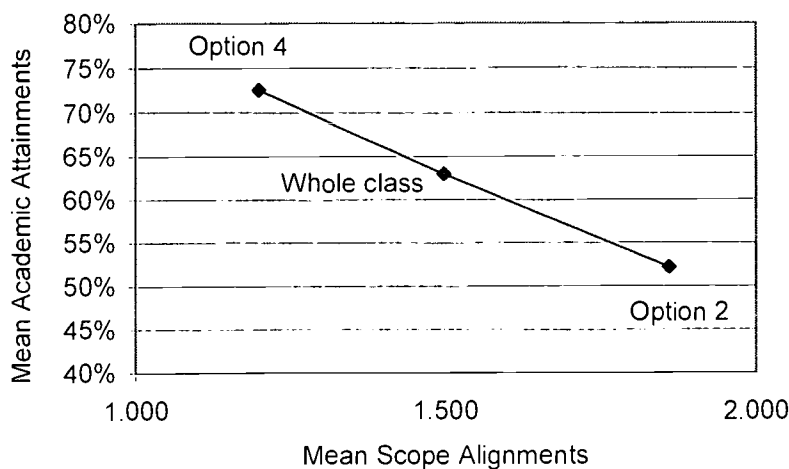


The means of post-course academic results for the whole class and for the two option groups have also been calculated and are also shown in Table 1 in Part 3 Summary Results. These are abstracted from Table 1 and are listed in Table 6. Their inter-relationship, illustrated in Figure 4, is inverse as predicted by the theory.

Table 6: Mean Scope alignments and academic attainments for the whole class and sub-groups.

	Means	
	Scope Alignment	Academic Attainment
Whole Class	1.499	63.0%
Sub-Groups		
Option 2	1.861	52.2%
Option 4	1.200	72.5%

Figure 4: Relation between means of Scope alignment and means of academic attainment



The 'validation correlations' column in Part 3 of Table 1 shows that the overall correlation of attainment and alignment of Scope for the group is -0.265; that is, the closer the alignment then the higher the student's academic result. This validates the prediction of academic attainment by alignment of Scope for the whole class. Further evidence validating Scope alignment as a predictor of academic attainment is also given in the section on sensitivity analysis below.

Calculating Alignment of Proportion

The second in-course formative indicator is the alignment of Proportion. This is a predictor of enjoyment of teaching, which is the second criterion of quality teaching. The alignment of Proportion is calculated in the same way as the alignment of Scope except that the two Proportions represented by each process objective are used in place of the raw ratings. This is illustrated in Table 7 for student #12.

Table 7: Calculation of Proportion Alignment

#12	LECTURER'S RATINGS					STUDENT'S RATINGS					ALIGNMENT	
	IS NOW		SHOULD BE		CHANGE (L)	IS NOW		SHOULD BE		CHANGE (S)	S-L	ABSOLUTE
	Rating	Proportion	Rating	Proportion		Rating	Proportion	Rating	Proportion			
SKILLS	30	0.231	60	0.387	68%	50	0.213	50	0.206	-3%	-71%	71%
UNDERSTANDING	40	0.308	45	0.290	-6%	95	0.404	98	0.403	0%	5%	5%
ATTITUDE	60	0.462	50	0.323	-30%	90	0.383	95	0.391	2%	32%	32%
Totals	130	1	155	1		235	1	243	1		TOTAL Pro ALIGNMENT	109%

We can replace both the 'is now' and 'should be' raw ratings of any process objective by their Proportions of the total of these three ratings. For example, in Table 7 we see that the total of the lecturer's three raw ratings for 'is now' is $30+40+60=130$. Using this total the 'is now' Proportion for each process objective can be calculated. For Skills, the 'is now' Proportion is $30/130=0.231$. For Understanding, the 'is now' Proportion is $40/130=0.308$ and for Attitude the 'is now' Proportion is $60/130=0.462$. A calculation check is that the three Proportions should total to 1 e.g. allowing for rounding errors $0.231+0.308+0.462=1$, as shown. Similarly the lecturer's raw ratings of how the three process objectives 'should be' can be replaced by their Proportions of the 'should be' total of $60+45+50=150$. So the lecturer's raw rating of 60 for what Skills 'should be' is replaced by the Proportion for Skills of $60/150=0.387$. The lecturer's 'should be' Proportion for Understanding is $45/155=0.290$ and for Attitude the lecturer's 'should be' Proportion is $50/155=0.323$. The calculation check that the three Proportions sum to 1 gives us $0.387+0.290+0.323=1$, as shown.

The calculations for changes in Proportions and for alignments of Proportions are exactly the same as the calculations for changes in Scope and for alignments of Scope, except that they use the Proportions rather than the raw ratings. The lecturer's expected changes in the Proportions of the process objectives are given by the Proportions for 'should be' minus the Proportions for 'as is', and the result divided by the Proportion for 'as is'.

Using the Proportions: Change in Proportion = ('should be' - 'is now')/'is now'

It is seen from Table 7 that the change the lecturer expects in the Proportion of Skills is $(0.387-0.231)/0.231=68\%$. The change that student #12 expects in the Proportion of Skills is $(0.206-0.213)/0.213=-3\%$. It is interesting to note that although the change in Scope of Skills expected by student #12 is 0%, because her raw ratings are equal for 'is now' and 'should be', this student's expectation for change in Proportion of Skills is -3%, and not 0%, because the two equal raw ratings represent different Proportions of the total raw ratings for 'is now' and 'should be'.

The calculation of alignment of Proportion for each process objective is similar to the calculation for the alignment of Scope, namely 'Change in Proportion expected by the Student (S)' minus 'Change in Proportion expected by the Lecturer (L)':

$$\text{Alignment of Proportion} = S - L$$

For example, Table 7 shows that the alignment of Proportions of Skills for student #12 is $-3\% - 68\% = -71\%$. The minus sign indicates that the student's expectation for change is below that of the lecturer. As with the alignments of Scope, descriptive statistics of these positive and negative alignments of Proportions are reported individually and by student-groups as the basis of diagnostic reports for the improvement of teaching. However, as with alignments of Scope, it is the absolute values that are summed to give the alignment of Proportion.. The absolute alignments of Proportion are in-course formative indicators that predict students' enjoyment of teaching.

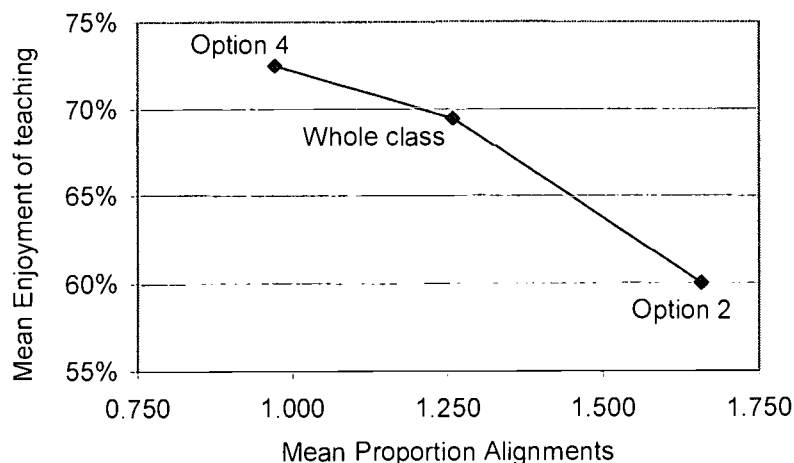
Validating Proportion alignment as a predictor of enjoyment of teaching.

Part 3 of Table 1 reports both the mean alignment of Proportions and the mean enjoyment of teaching for the whole class and for two of the option groups. These results are abstracted and listed in Table 8 and the relationship between them is illustrated in Figure 5, which again shows the inverse relation predicted by the theory. Although the sizes of the sub-groups were small, these comparative sub-group results are also in agreement with the Alignment theory. Using the Student Variables we can do similar analyses for any subgroup of interest.

Table 8: Means of Proportion alignments and enjoyment of teaching for the whole class and sub-groups.

	Means	
	Proportion Alignment	Enjoyment of Teaching
Whole Class	1.259	69.5%
Sub-Groups		
Option 2	1.658	60.0%
Option 4	0.972	72.5%

Figure 5: Resulting relation between means of Proportion alignment and means of enjoyment of teaching as predicted by theory



The 'validation correlations' column in Part 3 of Table 1 shows that the overall correlation of enjoyment and alignment of Proportions for the group is -0.278 . This validates the prediction of enjoyment of teaching by alignment of Proportions for the whole class. Further evidence validating Proportion alignment as a predictor of enjoyment of teaching is given in the section on sensitivity analysis below.

Sensitivity analysis (SA) for calculating changes that optimize teaching and learning

The Alignment software uses a standard Excel linear programming algorithm to find those lecturer changes that result in the best/minimum alignment. There are many choices of what to minimise or maximise for this calculation and these depend on (i) the indicator of most interest, (ii) the malleability of student expectations and (iii) the lecturer's freedom to adjust course expectations. Applications determining these choices are discussed in the 'Discussion' section of this paper. The first example in Table 1 minimises the mean Scope alignment of 1.499 for all the students down to 0.674 and calculates the 'Best' changes that would give this minimised mean Scope alignment. The resulting 'Best' changes, in bold type, are shown in Part 3 of Table 1 as 0% for Skills, 10% for Understanding and 19% for Attitudes. Given the lecturer's initial evaluation of the three process objectives for the whole class as 30, 40 and 60, these optimum changes imply that the lecturer should have been working towards $30+30\times 0\%=30$ (no change), $40+40\times 10\%=44$ and $60+60\times 19\%=71$. These 'Best' changes for the whole class are shown for joint comparison in Part 1 of Table 1 under the lecturer's Start ratings. If the lecturer had worked to these 'Best' changes then the students' Scope and Proportion alignment scores would have changed and the correlations of academic attainment with their new Scope alignments and Proportion alignments would have improved from -0.265 and -0.278 to -0.307 and -0.576 respectively. This sensitivity analysis again demonstrates (i) the predictive validity of the Alignment indicators, in that as Scope alignment and Proportion alignment improve their correlations with attainment and enjoyment also improve, and (ii) the validity of the theory that the better the Scope alignment then the higher is the mean academic attainment and the better the Proportion alignment then the more the students enjoy the teaching.

A similar sensitivity analysis was done separately for the History and Modern Language option groups by minimising their mean Scope alignments to find the best changes for these two sub-groups. Table 1 Part 3 shows that the best alignments for these two groups are 1.221 and 0.223 respectively which would have been given by the optimum 'Best' changes in the three process objectives of 0%, 33% and 9% for the History students and 13%, 2% and 6% for the Language students.

If the lecturer had made these 'Best' changes for minimising the Scope alignment, then the mean Proportion alignments for these two option groups would also have improved from 1.658 to 1.226 for the History students and from 0.972 to 0.203 for the Modern Language students, modelling the relationship between enjoyment and attainment, and predicting greater enjoyment and attainment for both of these student-subgroups.

Traditional SETs are a 'post mortem' assessment, collected at the end of the course when it is too late to use this feedback to help the students who made the assessments. However, a lecturer does not have to wait until the course is over to obtain diagnostic feedback and to optimize teaching using the Alignment method. The data collected in-course can be processed by this same type of sensitivity analysis to calculate the optimum changes that should be made by the lecturer during the course to maximize the students' post-course academic attainment and/or enjoyment of teaching.

Administrative decision point assessment of quality teaching

The lecturer may utilize the five-minute Alignment form many times during the course to keep his/her teaching on track. The administration uses it just once near the end of the course to calculate the final Alignment score for that lecturer's quality of teaching. This results in a single decision point number that can be compared across the institution and used for promotion and tenure decisions.

It will be noticed from Table 1 that the minimum alignment that is possible for this group is 0.674. Remember that the best alignment is the one closest to the perfect score of zero. The minimum possible alignment for the History students was much higher at 1.221 than for the Modern Language students at 0.223. These minimum possible alignment scores illustrate the best teaching/learning that is possible with these sub-groups of students and reflects the fact that students are not all equally amenable to required educational changes in Skills, Understanding and Attitudes. To give the lecturer some protection from such intransigence the decision point measure of quality teaching is taken as the actual alignment less this minimum/best possible alignment. For example, referring to the data given in Table 1, given the alignment score for the whole class is

1.499 and the best possible alignment for the whole class is 0.674, the Quality Teaching (QT) score for the whole class is $1.499 - 0.674 = 0.825$. These results from Table 1 are summarised in Table 9.

Table 9: Quality Teaching (QT) scores for whole class and for student sub-groups accounting for student intransigence.

	Mean Alignment Scores			Mean Academic Attainment
	Actual Scope	Best Scope	QT Score	
Whole Class	1.499	0.674	0.825	63.0%
Sub-Groups				
Option 2	1.861	1.226	0.635 high QT	52.2%
Option 4	1.200	0.223	0.977 low QT	72.5%

Table 9 illustrates a novel research application of the Alignment method. It measures, for the first time, the differential effort that teachers expend in teaching mixed ability students. Educators generally accept that teachers expend more effort teaching ‘less-able’ students than in teaching the ‘more-able’ students in their classes. It is thought that the ‘more-able’ students, being more independent, can manage more on their own. For example, as students improve they become less dependent on teacher assistance (Davis, 1998) and higher ability students use their time more productively while waiting for teacher assistance (de la Cruz, 1995).

It can be noticed from Table 9 that the quality of teaching was skewed more towards the needs of the more intransigent group; Option 2 History students. The quality of teaching experienced by the History Students (option 2, QT=0.635) was 0.342 better than that experienced by the Modern Language students (option 4, QT=0.977). Table 1 and Table 9 show that this greater teaching quality produced a mean academic attainment of only 52.2% compared to the mean academic attainment of 72.5% for the Modern Language students who experienced a 54% lower quality of teaching.

Discussion

This article has introduced the Alignment alternative to traditional student evaluations of teaching (SETs). The method aligns changes in emphases expected by the students and their lecturers in the three operationally defined process objectives of Skills, Understanding and Attitudes. The theory is that students will achieve higher academic standards and enjoy the course teaching more if they and their lecturers are working towards the same changes. This Alignment is a proxy measure predicting two teaching outcomes. These are the two criteria of quality teaching that are used by the method; academic attainment and enjoyment of teaching. By using this proxy measure, the Alignment method avoids restrictions imposed upon the teaching process by the requirement of traditional SETs to operationally define Quality Teaching via the rating questions on the traditional SET forms.

The Alignment method separates the measurement of these two outcome criteria so as to avoid the ‘smile sheet’ criticisms levelled at traditional SETs. It also separates the post-course measurement of these criteria from the measurement of in-course formative Alignment predictors of quality teaching. The in-course alignments are introspective ‘non-threatening’ ratings that students are pre-trained to use, whereas traditional SETs are one of the few evaluations affecting salaries and employment retention that are performed by untrained anonymous evaluators. Students are expected to pass a simple institutional test that qualifies them as raters. The short briefing for this test helps as an introduction to the lecturers’ briefing on their specific uses of the process objectives in the teaching and assessment of their courses. It accredits students as qualified raters and is intended to raise the importance, and quality of responses above that which low response rates and ill considered responses indicate that some students typically associate with the use of traditional SETs. The 5 minute feedback form is relatively quick to administer and process. Because the form is confidential, and not anonymous, the results can be used to identify the quality of teaching experienced by individuals and by student sub-groups for whom the quality of teaching is a particular concern.

Although this paper has detailed and justified the simple calculations of alignment for the purposes of elucidation, these calculations are normally computed by the Alignment software, which also uses the

components of the calculations to offer detailed diagnostic measurement based reports to improve the teaching experienced by identifiable individuals and sub-groups. Hence, the method can be used under the control of lecturers, usually two or three times in-course, to adjust their teaching and iron-out problems identified before the end of course assessment by the administration. The method results in a single decision point indicator of quality that can be used by the administration for equitable promotion, award and tenure decisions across the institution. The control, and targeted opportunities for improvement, that this method places in the hands of lecturers is intended to ameliorate feelings of threat and manipulation that can be engendered by traditional SETs.

Unlike traditional SETs that are rarely validated, the Alignment method is validated on each course and each student sub-group with which it is used. It is validated by comparing, for example by correlating, the in-course predictive alignments with the post-course criteria of teaching, and this has been demonstrated in this paper. In addition, the theory is validated by sensitivity analyses that use standard linear programming software to show that the predictive correlations between the in-course indicators and post-course criteria of quality teaching improve when the alignments are minimised. The more aligned students and their lecturer were on Scope then the higher were the students' academic results. Also, the more aligned students and their lecturer were on Proportion then the more the students enjoyed the teaching. These results agree with the theory. This same sensitivity analyses calculates the 'Best' possible changes in teaching that will optimally align teaching and learning to produce the highest academic attainments and enjoyment of teaching. A focus of this paper has been that this optimization of teaching can be done in-course. The sensitivity analysis can be used in-course to notify the lecturer of the changes in emphases of the three process objectives that would optimize the teaching experience for any student or student sub-group in the class. Another problem of traditional SETs is that they can not identify and compensate for low-ability over-confident students who blame the lecturer for their poor results. This paper has shown how the calculation of student intransigence protects lecturers from such 'blaming' feedback.

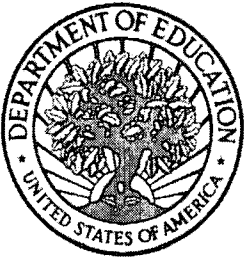
The precise information provided by the Alignment method identifies how to optimize alignment. However, if the changes corresponded to a reduction in expected quality of the course and these are implemented by the lecturer, then this will result in 'dumbing down' associated with traditional SETs. The Alignment method allows institutions to be protected from lecturers 'dumbing down' courses to improve their Alignment scores. This can be done by requiring pre-negotiated final 'should be' ratings that correspond to the institutions values of quality for that course, towards which the lecture should work. Similarly, the lecturer is protected from high institutional expectations that are impractical due to the intransigence of the students registered for the course. By making these expectations explicit and quantifiable the Alignment method protects both the institution and the lecturer. The paper has shown how intransigence, or teaching difficulty, is identified for each student, student sub-group and each course, and how this is allowed for in the calculation of quality teaching. This is particularly necessary where faculty are expected to teach subjects that challenge the values of their students.

As the sensitive analysis gives the optimum changes required for the student cohort, these changes can be used to work backwards from the institutional expectations to calculate the minimum current threshold level at which the students need to be in order to reach the final institutional expectation for the course. This threshold level can be compared with the actual current student level, as computed from their eight ratings, and the difference used to assess the need to change the institutional expectations of course quality and/or the quality of the student intake to perhaps make quality teaching more viable for the course.

It can be seen that the Alignment method uses the influence of assessment to improve both the quality of teaching and learning. In particular, it rewards lecturers for emphasising appropriate degrees of Understanding and Attitude, as well as Skills, in their teaching and assessments. It also rewards students for emphasising appropriate degrees of Understanding and Attitude, as well as Skills, in their learning and assessed assignments. For example, assessing Understanding by the justifications of novel application, as modelled in the teaching, is intended to promote critical thinking.

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